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To study risk factors of degenerative rotator cuff tear

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Abstract

Background: Rotator cuff has been a known entity for orthopaedic surgeons for more than two hundred years [1]. Rotator cuff disease is a common condition that causes shoulder pain and functional disability with a prevalence rate of 2.8-15%, affecting approximately 40% of population who are more than 60 years of age and substantially impacting on an individual's function [2].

Aims and Objectives: To study risk factors in patients with symptomatic atraumatic rotator cuff tear – Age, Obesity, Gender, Smoking, Diabetes mellitus, Hypertension, Hand dominance, Use of corticosteroid injections, Hyperlipidemia, Osteoarthritis of knee.

Materials and Methods:

Inclusion criteria

- Pain in the shoulder of duration of more than three weeks.
- Normal range of motion of the shoulder.
- One or more than one positive clinical tests for rotator cuff tear.

Diagnostic imaging like ultrasound and magnetic resonance imaging pointing to the diagnosis of rotator cuff tear.

Exclusion criteria

- History of trauma.
- History of any surgery.
- Patients using assisted devices for walking.

Results: Our study proved that the metabolic factors of diabetes, BMI, age, hand dominance, osteoarthritis of knee, hypertension, gender were independent significant risk factors associated with the development of atraumatic rotator cuff tears. Out of all the risk factors evaluated, osteoarthritis of knee, age, obesity were the most significant risk factors for atraumatic rotator cuff tear.

Conclusions: Out of all risk factors evaluated, osteoarthritis of knee, obesity and age were the most important risk factors for atraumatic rotator cuff tear

Evaluation of various risk factors results in enhanced understanding of the prevention and management of various other common conditions and comorbidities associated with degenerative rotator cuff tears [26].

Keywords: Degenerative rotator cuff, BMI, atraumatic, osteoarthritis, hyperlipidemia

Introduction

Rotator cuff has been a known entity for orthopaedic surgeons for more than two hundred years [1]. Rotator cuff disease is a common condition that causes shoulder pain and functional disability with a prevalence rate of 2.8-15%, affecting approximately 40% of population who are more than 60 years of age and substantially impacting on individual's function [2].

The prevalence of rotator cuff tendon tears both symptomatic and asymptomatic increases with age ranging widely from 0% to 15% after the 50's to 30% to 50% in the 80's.

Rotator cuff tears are either traumatic or degenerative, degenerative tears are far more frequent and multifactorial in etiology. Various intrinsic and extrinsic factors contribute to the causation of rotator cuff pathology [3].

Aging can contribute to dysfunction of scapular muscles and result in degenerative rotator cuff tears [4]. An age related decrease in vascularity is consistent with the increasing prevalence of cuff pathology with aging. There is relative hypovascularity of the deep surface of the supraspinatus insertion.

Effect of obesity on tendon degeneration is cellular inflammation through the disturbed production of adiponectin and increased leptin resistance induce intracellular reactive oxygen

species which induce inflammation and apoptosis of cells.

Keener *et al.* reported that hand dominance is related to symptomatic rotator cuff tears, especially tears involving shoulder pain [5].

Djerbi *et al.* reported that the prevalence of rotator cuff tears was greater among patients with dyslipidemia [6]. In hyperlipidemia environments, lipids accumulate within the extracellular matrix of the tendon and thus affect the mechanical properties of tendon.

Baumgarten *et al.* found that 61.9% of patients with degenerative rotator cuff tear had a history of daily tobacco smoking [7]. Tobacco smoking has been associated with musculoskeletal pain dysfunction with nicotine implicated in delaying tendon to bone healing.

Degenerative rotator cuff tears are more common in females as compared to males as there are differences in activities of daily living between men and women that may require different ranges of shoulder motion [8]. Atraumatic rotator cuff tear is more common in post-menopausal women.

Denaro V *et al.* showed that there is a possible relationship between hyperglycemia and collagen structure alteration [9]. Tendon degeneration in diabetes results from the formation of advanced glycation end products and from subsequent cross-linking within collagen fibres, which can deteriorate mechanical function [10].

People who use upper extremity joints as the primary weight-bearing joints of the body creates a dynamic relationship between mobility and stability, which can lead to a specific subset of pathology [11]. Patients who have osteoarthritis knee might cause additional strain to their shoulders while getting up from standing or sitting position.

Arterial hypertension is a cause of peripheral hypovascularity, so patients with hypertension have a risk of degenerative rotator cuff tear [12]. High blood pressure is associated with a twofold higher risk of having a complete rotator cuff tear, two-fold higher risk of having a large tendon tear involving more than one tendon. Identification of degenerative rotator cuff pathology, its etiological risk factors and initiation of measures designed to maintain acceptable shoulder function is a must to reduce the prevalence of degenerative rotator cuff pathology [13].

Targeting and reducing costs of rotator cuff repair can reduce overall health care expenditure by as much as an estimated \$80 to \$ 262 million per year [14].

We conducted a study involving 50 patients coming to orthopaedic OPD of Shri Guru Ram Das Hospital Vallah, Amritsar was to evaluate the risk factors for degenerative rotator cuff tear in the general population. The study involved a group of Indian rural population (50 subjects) diagnosed with atraumatic rotator cuff tear on a clinical and radiological basis for evaluation of following risk factors.

- Age
- Gender
- Obesity
- Smoking
- Diabetes mellitus
- Hypertension
- Osteoarthritis of knee
- Hand dominance
- Hyperlipidemia
- Repeated corticosteroid injections

Evaluation of various risk factors results in an enhanced understanding of the prevention and management of various other common conditions and comorbidities associated with

degenerative rotator cuff tears [15].

Degenerative rotator cuff tear causes high healthcare costs in industrialized countries, so better understanding and evaluation of risk factors, associated comorbidities will reduce the psychological distress, improve people quality of life and capacity to work [16].

Aim and Objectives

To study risk factors in patients with symptomatic atraumatic rotator cuff tear -

- Age
- Obesity
- Gender
- Smoking
- Diabetes mellitus
- Hypertension
- Hand dominance
- Use of corticosteroid injections
- Hyperlipidemia
- Osteoarthritis of knee

Material and Methods

Source of data

Out of patients presenting to the outpatient department of Orthopaedics of Sri Guru Ram Das Institute of medical sciences and research, Amritsar, patients with signs and symptoms of shoulder, subjected to ultrasound and magnetic resonance imaging evidence as having rotator cuff tear were selected for the study.

Inclusion criteria

- Pain in the shoulder of duration more than three weeks.
- Normal range of motion of the shoulder.
- One or more than one positive clinical tests for rotator cuff tear.
- Diagnostic imaging like ultrasound and magnetic resonance imaging pointing to the diagnosis of rotator cuff tear.

Following clinical examination was done in the shoulder for clinical diagnosis of rotator cuff tear-

Test for supraspinatus

Jobe test

The test was performed by placing the shoulder in 90 degrees of abduction and 30 degrees of forwarding flexion and internally rotated so that the thumb was pointing toward the floor. Muscle testing against resistance showed weakness or insufficiency of the supraspinatus owing to a tear or pain associated with rotator cuff impingement.

Test for subscapularis

Belly press test

Used for patients who had decreased internal rotation, the patient pressed the abdomen with the flat of the hand and attempted to keep the arm in maximal internal rotation. If active internal rotation was strong, the elbow did not drop backward. If the strength of subscapular was impaired, maximal internal rotation could not be obtained. The patient exerted pressure on the abdomen by extending the shoulder rather than by internally rotating it.

Lift off test

They were used for detection of isolated rupture of the subscapularis tendon. With the patient seated or standing, the

arm was internally rotated and the dorsum of the hand was placed against the lower back. If the patient was unable to lift off the dorsum of the hand off the back, the test was positive.

Test for teres minor

Patte Hornblower sign

The Patte sign was used to determine the strength of the teres minor. With the patient standing, the examiner elevated the patient's arm to 90 degrees in the scapular plane and flexed the elbow to 90 degrees. The patient was then asked to laterally rotate the shoulder.

Test for infraspinatus

External rotation stress test

The test was used to test the integrity of external rotators of the shoulder, specially the infraspinatus and teres minor. With the patient arms by his or her side in neutral flexion and abduction, shoulders were externally rotated 45 to 60 degrees. The examiner applied force against the dorsum of the hands, while the patient was asked to resist. Pain and weakness depicted inflammation or tearing of infraspinatus or teres

minor or both supraspinatus.

Diagnostic imaging pointing to the diagnosis of rotator cuff tears

Ultrasound imaging

USG as an imaging modality was utilized to perform a dynamic evaluation of the rotator cuff and long head of the biceps. Dynamic ultrasound was used in the diagnosis of degenerative rotator cuff pathology. A 7.5-MHz transducer was used and the deltoid muscle, subacromial-subdeltoid bursa, long head of the biceps tendon, and entire rotator cuff were examined, with special emphasis on the integrity of the subscapularis tendon (SSC), supraspinatus tendon (SSP), infraspinatus tendon (ISP), and teres minor tendon (TM).

The ultrasound criteria used for the diagnosis of partial-thickness rotator cuff tears were focal partial-thickness rotator cuff discontinuity (i.e. a focal hypoechoic zone or mixed hyper- and hypoechoic zone) involving the articular or bursal side or located within the tendon, and focal thinning (flattening) of the rotator cuff or loss of convexity of the outer border (bursal surface) of the rotator cuff.



Fig 1: Ultrasound imaging of rotator cuff tear showing supraspinatus full thickness tear

Magnetic resonance imaging

The accuracy of MRI as a diagnostic tool for full thickness rotator cuff tears was excellent. 1.5 tesla MRI machine was used for imaging. MRI imaging of the shoulder was done in FSPD (fat sac protein density), including combination of T1 and T2 weighted images. Supraspinatus tendon tear was best appreciated on coronal views, subscapularis on axial views and the sagittal view was used for an overall assessment of the involvement of all tendon tears.

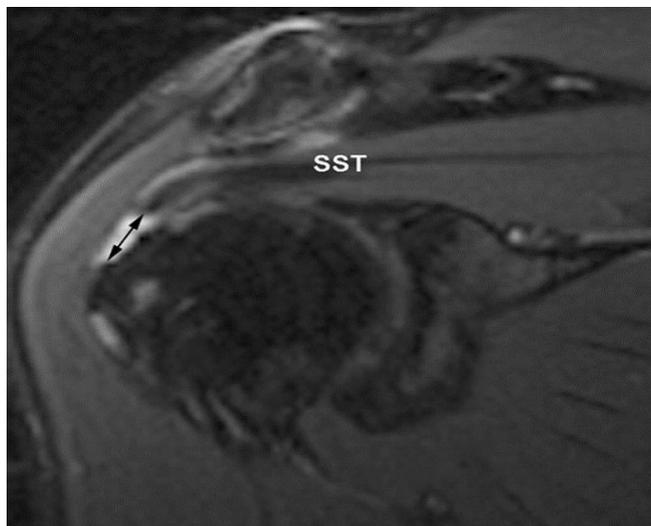


Fig 2: Focal full-thickness supraspinatus tendon tears. Double-headed arrow indicates the greatest dimension of the tears. GT = greater tuberosity

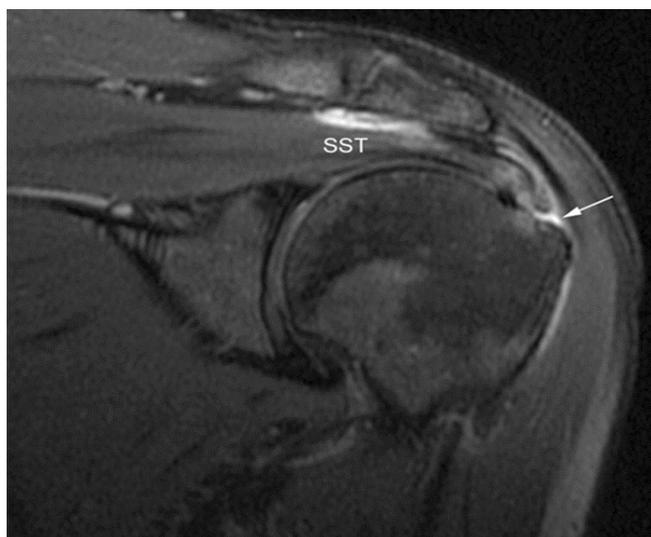


Fig 3: Partial-thickness supraspinatus tendon tears. Coronal oblique fat-saturated T1-weighted MR image (570/11) shows an articular-surface partial-thickness tear (arrow) in the distal supraspinatus tendon (SST)

Exclusion criteria

- History of trauma.
- History of any surgery.
- Patients using assisted devices for walking.

Design of study

Observational study

Duration and purpose of the study

The study was conducted from January 2019 to September 2020 at Sri Guru Ram Das Institute of Medical Sciences and

Research, Vallah, Amritsar and the purpose of study was a descriptive analysis of 50 cases of degenerative (symptomatic) rotator cuff tear for assessment of following risk factors-

- Age
- Gender
- Obesity-Measured using body mass index values

Table 1: BMI = Weight (KGS) / Height (M²)

WHO classification	BMI (World)
Underweight	<18.5
Normal BMI	18.5-24.99
Overweight	25-29.99
Obesity	>30

- Smoking- A smoker is someone who smokes any tobacco product either daily or occasionally according to WHO smoking and tobacco use policy.
- Diabetes- Measured using HBAIC VALUES (value more than 6 suggested diabetes as a risk factor for atraumatic rotator cuff tear)
- Hypertension- Value of hypertension (systolic blood pressure value more than 120mm/hg)
- Hyperlipidemia- Total cholesterol values was used to rule out hyperlipidemia as a risk factor
- Value more than 200 mg/dl suggested hyperlipidemia
- Use of corticosteroid injections- History of Number of Corticosteroid Injections in past
- Osteoarthritis of knee

Table 2: Kellgren Lawrence classification for osteoarthritis of knee (Based on weight bearing AP X-ray)

Grade	Description
0	Normal
I	Unlikely narrowing of the joint space, doubtful osteophyte
II	Small osteophytes, possible narrowing of the joint
III	Multiple, moderately sized osteophytes, definite joint space narrowing, some sclerotic areas, possible deformation of bone ends
IV	Multiple large osteophytes, severe joint space narrowing, marked sclerosis and definite bony end deformity

- Hand dominance

Discussion

The natural history of atraumatic rotator cuff disease follows a predictable clinical path. The last half-decade has seen significant advances in our understanding of the natural history of rotator cuff disease [17]. Studies have continued to provide valuable insight into the clinical, radiographic, and anatomic features of these atraumatic tears. The risk factors for tear progression in symptomatic rotator cuff tears have not been clarified yet. It is important for orthopaedic surgeons to know the natural course of tear progression when non-operative management is to be chosen. The identification of risk factors of atraumatic rotator cuff tear characterized by few and mild symptoms, would allow early preventive interventions, with the aim of modifying the course of the disease [18].

In the present study, 50 cases of atraumatic rotator cuff tear presenting to the outpatient department of Sri Guru Ram Das Institute of Medical Sciences and Research, Vallah, Amritsar were diagnosed clinically and radiologically for evaluation of following risk factors-

- Age
- Gender
- Smoking
- Obesity
- Hyperlipidemia
- Hypertension
- Hand dominance
- Diabetes
- Osteoarthritis of knee
- Use of corticosteroid injections

Our study proved that the metabolic factors of diabetes, BMI, age, hand dominance, osteoarthritis of knee, hypertension, gender were independent significant risk factors associated with the development of atraumatic rotator cuff tears. Out of all the risk factors evaluated, osteoarthritis of knee, age, obesity were the most significant risk factors for atraumatic rotator cuff tear.

In our present study, *p* value for osteoarthritis of knee as a risk factor was significant. Majority cases of degenerative rotator cuff tear-56 percent (28) had osteoarthritis of knee and 22 patients had no such history, proving it as a significant risk factor for degenerative rotator cuff tear. People who used upper extremity joints as the primary weight-bearing joints of body created a dynamic relationship between mobility and stability, which led to atraumatic rotator cuff tear. Patients who had osteoarthritis knee might cause additional strain to their shoulders while getting up from standing or sitting position^[11]. This risk factor evaluated was in discordance to the study conducted by Hyung *et al.* in 2018 on risk factors of posterosuperior atraumatic rotator cuff tear in which this factor had no place in tear causation.

The present study proved age to be a significant risk factor for atraumatic rotator cuff tear six patients were in age group of 30 to 40 years, 28 patients were in the age group of 41 to 50 years and 28 patients in age group 51 to 60 years. Our study further establishes that age is an independent risk factor for an atraumatic rotator cuff tear, supporting the consensus that an atraumatic rotator cuff tear is a result of the degenerative process that accompanies aging. Tendons in the elderly have a significantly compromised microvascular system making the patient more prone to degeneration, microtears, calcification, fibrovascular proliferation and general insult. The result proved here is in concordance to the study conducted by Sayampanathan *al* in 2017 and Moosmayer *et al.* on systemic risk factors for rotator cuff tear in which the odds of an individual aged 60 years and above sustaining a RCT was 5.07 times higher than an individual less than 60 years old (*p*< 0.001).

Secondly, obesity and hypertension were significant risk factor for atraumatic rotator cuff tear according to *p* value. Majority of patients (36) had BMI more than 25 and only 28 percent cases had BMI less than 25 proving it to be the second most important risk factor after osteoarthritis of knee for atraumatic rotator cuff tear. 36 patients were hypertensive and only 14 patients were non-hypertensive. Data collected from present study was in accordance to study conducted by Gumina *et al.* in 2013 and in 2014 on association between, body fat and rotator cuff tear in which patients with RCT had a BMI higher than that of subjects with no RCT in both groups, (*P*=0.031). It has been BMI and % BF, is a risk factor for the occurrence and severity of degenerative rotator cuff tear and hypertension was associated with a 2-fold higher risk of tear occurrence^[14].

This study proved diabetes as a significant risk factor for

atraumatic rotator cuff tear, majority of patients were diabetics (37) with HBAIC value more than 6 and only 13 patients had HBAIC value less than 6. The finding that diabetes is strongly associated with atraumatic rotator cuff tears is consistent with the findings of several previous studies conducted by Hyung *et al.* in 2018 noting diabetes as a risk factor for a atraumatic rotator cuff tear and metabolic syndrome, which is strongly related to insulin resistance and hyperglycaemia, is also associated with it.

In this present study, sixty percent of degenerative rotator cuff tear patients were females and only 40 percent patients were males This result is in discordance to the study conducted by Gumina *et al.* in 2013 who proved that gender was not a significant risk factor for degenerative rotator cuff tear. Moreover, hand dominance was proved as a risk factor of degenerative rotator cuff tear This result was same according to the data collected from previous study conducted by Keener *et al.* and Hyung *et al.*, in 2018 who reported that hand dominance was related to symptomatic rotator cuff tears, especially tears involving shoulder pain and present study proved that degenerative rotator was more common in dominant shoulder of patients^[16].

In this study, hyperlipidemia, use of corticosteroid injections and smoking were a not significant risk factor for atraumatic rotator cuff tear. The majority of patients of atraumatic rotator cuff tear had hypolipidemia and only 16 patients were hyperlipidemic. Our study gave results similar to the study conducted by Djerbi *et al.* 2015 in a case-control study, who found that patients with dyslipidemia had a higher prevalence of rotator cuff tears^[19]. 32 patients of atraumatic rotator cuff tear had no history of corticosteroid injections in past and 18 patients had such history. This result is in discordance to previous study conducted by Gialanella B *et al.* to study the effect of intraarticular injections of corticosteroids (triamcinolone) in patients with symptomatic rotator cuff tears^[20] and Keith *et al.* who hypothesized that history of cigarette smoking was more prevalent in patients with rotator cuff tears compared with patients without rotator cuff tears^[21]. Moreover as the present study was conducted in the outpatient department of the hospital, majority of patients coming were from Sikh families and smoking was not common in Sikh population.

Despite several advantages it had few limitations that an observational study of 50 symptomatic cases of atraumatic rotator cuff tear presenting to the orthopaedics OPD was conducted who might not be entirely representative of the entire population. Sample size of study population was less, secondly it involved only rural group of population which did not represent population as a whole. If this study involved a larger rural group of study population including urban population, the results would have been different.

Summary and Conclusion

Our study proved that the metabolic factors of diabetes, BMI, age, hand dominance, osteoarthritis of knee, hypertension, diabetes were important risk factors associated with the development of atraumatic rotator cuff tears, Moreover hyperlipidemia, use of corticosteroid injections, smoking had no role in increasing the prevalence of degenerative rotator cuff tear in population. Out of all risk factors evaluated, osteoarthritis of knee, obesity and age were the most important risk factors for atraumatic rotator cuff tear. Moreover as this study was conducted in the outpatient department of hospital, majority of patients coming were from Sikh families and smoking is not common in Sikh population,

so smoking was not significant risk factor for atraumatic rotator cuff tear.

Evaluation of various risk factors results in enhanced understanding of the prevention and management of various other common conditions and comorbidities associated with degenerative rotator cuff tears [15].

Despite several advantages, it had a few limitations as it was an observational study, so it could not represent the entire

population. A sample size of study population was less, secondly it involved only rural group of population which did not represent population as a whole. If this study involved a larger rural group of study population including urban population, the results would have been different.

Tables

Table 3: Showing number of cases of degenerative rotator cuff tear according to age

Age (years)	No. of cases	% age
30-40	6	12.00
41-50	16	32.00
51-60	28	56.00
Total	50	100.00

Mean 50+/-7.4 yrs. R²: 0.200; F: 12.002; p=0.001.

Table 4: Showing number of cases of degenerative rotator cuff tear according to sex

Sex	No. of cases	% age
Female	30	60.0
Male	20	40.0
Total	50	100.0

Table 5: Showing number of cases of degenerative rotator cuff tear according to body mass index

BMI (Measured using weight in kgs/height in metre square)	No. of cases	% age
<18.5 (Underweight)	0	0
18.5-24.99 (Normal)	14	28.00
25-30 (Obese)	36	72.00
Total	50	100.0

R²: 0.101; F: 5.384; p=0.025

Table 6: Showing number of cases of degenerative rotator cuff tear according to diabetic history

Diabetes (Measured using HBAIC value)	No. of cases	% age
Patients with HBAIC value less than 6	13	26.0
Patients with HBAIC value more than 6	37	74.0
Total	50	100.0

R²: 0.154; F: 8.712; p=0.005

Hyperlipidemia

Table 7: Showing number of cases of degenerative rotator cuff tear according to hyperlipidemia history

Hyperlipidemia (Total cholesterol value >200 mg/dL-Hyperlipidemia)	No. of cases	% age
Patients with total cholesterol value <200	14	28.00
Patients with total cholesterol value >200	36	72.00
Total	50	100.0

R²: 0.061; F: 3.137; p=0.083.

Table 8: Showing number of cases of degenerative rotator cuff tear according to hand dominance

Hand dominance	No. of cases	% age
Non-dominant	9	18.00
Dominant	41	82.00
Total	50	100.0

Table 9: Showing number of cases of degenerative rotator cuff tear according to hypertension

Hypertension (Using systolic blood pressure Values – More than > 120mmHg – Hypertension)	No. of cases	% age
Patients with systolic BP 80-100 mmHg	4	8.00
Patients with systolic BP 100-120 mmHg	10	10.00
Patients with systolic BP 120-140 mmHg	11	22.00
Patients with systolic BP 140-160 mmHg	21	28.00
Patients with systolic BP 160-180 mmHg	4	16.00
Total	50	100.0

R²: 0.753 F: 146.48; p=0.001.

Table 10: Showing number of cases of degenerative rotator cuff tear according to osteoarthritis of knee history

Osteoarthritis of knee (Kellgren lawrence grading system)	No. of cases	% age
Patients with no history of osteoarthritis knee	22	44.0
Patients with history of osteoarthritis knee	28	56.0
Total	50	100.0

R²: 0.081; F: 4.205; p=0.046.

Table 11: Showing number of cases of degenerative rotator cuff tear according to smoking history

Smoker	No. of cases	% age
Positive smoking history	9	18.0
No smoking history	41	82.0
Total	50	100.0

Table 12: Showing number of cases of degenerative rotator cuff tear according to history of corticosteroid injection

History of corticosteroid injection (No. of injection history in past)	No. of cases	% age
Patients with no history of injection in past	32	64.0
Patients with one or more than one history of injection in past	18	36.0
Total	50	100.0

R²: 0.008, F 0.374, P 0.544

Case images

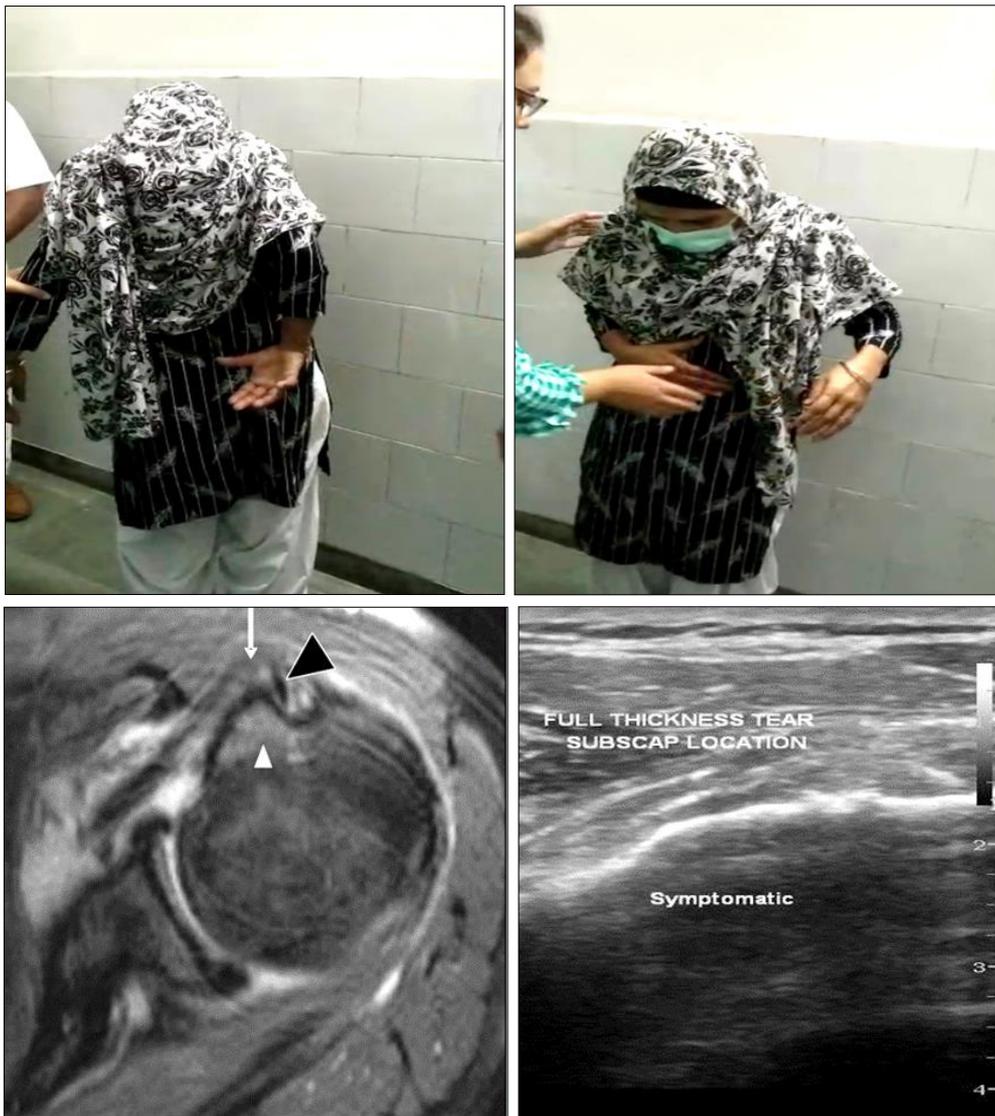


Fig 4: Showing 50 year old female with positive lift off and belly press test with subscapularis tendon tear on USG and MRI

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